# Treatment of severe persistent metatarsus adductus by abductor hallucis tenotomy and casting in children more than 2 years old

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**Background**
Treatment of metatarsus adductus depends on patient's age, osseous development, severity, and associated deformities.
**Patients and methods**
A total of 35 feet that presented with idiopathic severe metatarsus adductus were included. The mean age at the time of operation was 36 months. Abductor hallucis tenotomy was done in all patients.
**Results**
At final follow-up, 33 (94%) feet had satisfactory outcome, two (6%) feet had unsatisfactory outcome, and 30 feet (30/33) had excellent results, with normal heel bisector line and metatarsal angle (average, 12°; range, 8–14°).
**Conclusion**
Abductor hallucis tenotomy and casting is effective in the treatment of severe resistant metatarsus adductus.

**Keywords:**
abductor hallucis, metatarsal angle, metatarsus adductus

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## Introduction

Metatarsus adducts is one of the most common childhood foot deformities. It describes a medial deviation (adduction) of the forefoot. The lateral border of the foot is convex and the base of the fifth metatarsal has increased prominence. The medial aspect of the foot is concave. There may be a slight separation between the great and second toe [1].

Its incidence is estimated to be as high as 1 in 100 births [2]. The deformity usually presents at birth but may not present until the first year of life. Hip dysplasia and other associated anomalies should be excluded [3]. Pathogenesis is unknown but is believed to result from intrauterine crowding or positioning [2].

A dynamic imbalance or malinsertion of the abductor hallucis muscle has been proposed by several authors to be a contributing factor in the etiology of metatarsus adductus [4–6]. Thompson felt that congenital metatarsus adductus was in part caused by abnormal insertion of abductor hallucis and its accessories [7]. Peabody and Muro [8] first described an abnormal insertion of the tibialis anterior tendon distally and plantarly on the first metatarsal creating an abnormal mechanical advantage. Kite [9,10] agreed with this finding and added that both tibialis anterior and tibialis posterior were at an advantage and easily overpowered the peroneals producing the metatarsus varus deformity.

If managed early enough, a large majority of pediatric metatarsus adductus deformities are amenable to conservative treatment measures. The more resistant cases or those where treatment has been delayed may require more sophisticated and aggressive surgical treatment to restore normal alignment. Several variables exist that can be used as a guide in choosing the appropriate procedure. These include the patient's age, stage of osseous development, severity of the primary deformity, as well as the presence or absence of other deformities [7].

## Aim

The aim of this work was to evaluate the results of treatment of severe persistent metatarsus adductus by abductor hallucis tenotomy and casting in children more than 2 years old.

## Patients and methods

This study included 20 patients with 35 affected feet presented with idiopathic metatarsus adductus. This study was approved by institutional ethics committee in el Hadra University. A total of 15 (75%) feet were bilaterally and five (25%) were unilateral. There were 12 (60%) females and eight (40%) males. The mean age at the time of operation was 36 months and ranged from 30 to 60 months. They were classified as severe forms of

metatarsus adductus both clinically [11] (Fig. 1) and radiographically [12] (Fig. 2). All patients received a trial of conservative treatment by serial manipulation and casting before tenotomy procedure.

Abductor hallucis tenotomy was done in the operating room under general anesthesia. The foot, leg, and knee were prepared and draped. An assistant held the foot in abduction, a small 1 cm incision on the medial side of the base of the big toe was done, and the tendentious part of the muscle is dissected, identified, and cut (Fig. 3). After the tenotomy was performed, skin closure was done and then covered with a small sterile gauze and a sterilized soft roll. After tenotomies, above-knee plaster casts were applied with the foot abducted and the ankle in neutral. The casts were changed every 3 weeks for two times (6 weeks total) followed by medical corrective shoe until the child walked well.

An approval was provided by the institutional review board (IRB), and informed consents were obtained from parents.

**Figure 1**


In normal foot, the heel bisector intersects the second and the third toes. With increasing adduction, the heel bisector displaces toward the fifth toes [11].

**Figure 2**

Diagrammatic representation of the metatarsus angle. Normal less than 15, mild 16–25, moderate 26–35, and severe more than 35 [12].

**Figure 3**


(a) Abductor hallucis tendon before tenotomy. (b) Abductor hallucis tendon after tenotomy.

## Results

The mean follow-up period was 28±2 months and ranged from 24 to 36 months. At the end of follow-up, each foot was assessed clinically and radiographically to assess the final results. A total of 33 (94%) feet had satisfactory outcome, and 30 feet (30/33) had excellent results with normal heel bisector line and metatarsal angle (average, 12°; range, 8–14°) (Fig. 4). Three feet (3/33) had mild metatarsus adductus deformity with average metatarsal angle of 20°, but the parents were satisfied. Two (6%) feet had persistent deformity after tenotomy and 12-week casting and persistent difficulty with shoe fitting; they were treated by medial soft tissue release, closed wedge cuboid osteotomy, and open wedge medial cuneiform osteotomy with Kirschner wire fixation. Although the two feet with persistent deformity had an age older than 4 years (4.5, 5 years), the age had no statistically significant effect on the final outcome ($P$=0.821). It was found that sex and bilaterality had no statistically significant effect on the final outcome ($P$=0.625, $P$=0.750). The mean final metatarsal angle had no statistically significant effect on the final clinical outcome ($P$=0.722).

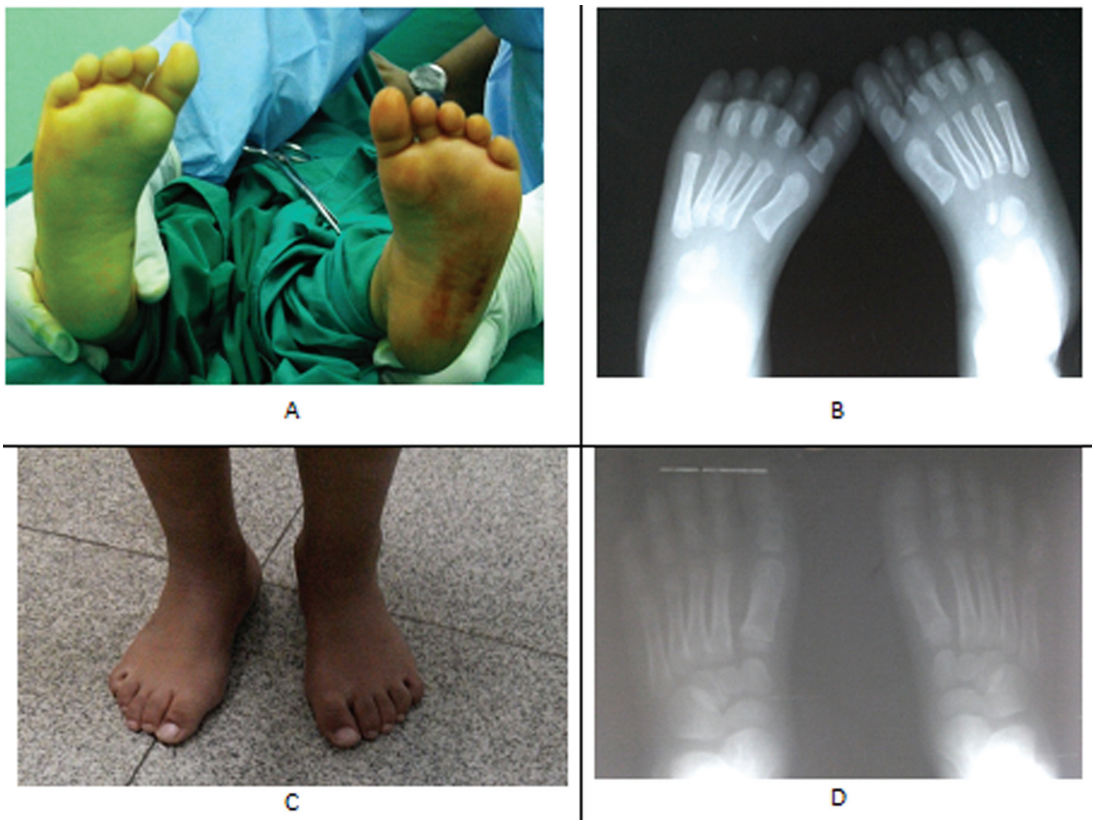
## Discussion

Although it is a relatively benign deformity that has been shown to produce minimal disability as an adult, children with metatarsus adductus may require surgical correction. Mild and moderate forms of metatarsus adductus tend to resolve spontaneously by 3 years of age. Children with types mild and moderate metatarsus adductus need only observation; occasionally, a corrective shoe or commercial orthosis can hasten correction [13].

The severe deformity is best managed by manipulation and serial casting. For best results, this should be performed before an infant reaches 8 months of age. The forefoot is manipulated into the correct position, whereas the hindfoot is supported in the neutral position and a short leg cast is applied. The cast is changed at 1-week to 2-week intervals until complete correction has been achieved. Most feet will correct in 6–8 weeks. After casting, the foot is maintained in a corrective shoe or an orthosis until the child is walking well [1,11]. In this study, all feet had received a trial of repeated manipulation and casting before the tenotomy procedure, but it failed; this was attributed to the older age of patients at the start of manipulation.

Some authors recommended that if a significant forefoot adduction is present in a child up to 6 years of age, a medial release followed by serial casting can be considered. After 6 years of age, tarsal or metatarsal

**Figure 4**




(a) Bilateral metatarsus adductus in a 2.5-year-old girl. (b) Preoperative plain radiograph. (c) Clinically fully corrected feet at the end of follow-up. (d) Plain radiograph at the end of follow-up with corrected metatarsal angle.

osteotomies are necessary [14]. In this study, the simple procedure of abductor hallucis tenotomy and casting was successful in 33 (94%) of feet and only two (6%) feet older than 4 years (4.5, 5 years) had persistent deformity after tenotomy and 12 weeks serial casting; they were treated by medial release, and cuboid and medial cuneiform osteotomies.

Some authors recommended resection of the entire abductor hallucis muscle with selective sectioning of fibers from the medial head of flexor hallucis brevis. They reported 90% good results with minimal complications. The most frequent complication was postoperative hallux valgus, which was treated with adductor tenotomies [4–6]. Sgarlato [15] advised against resection for the abductor hallucis for the aforementioned reasons. He felt that there was an anomalous insertion of the abductor hallucis into the first metatarsal head and recommended sectioning the tendon, lengthening, and reattaching it to the base of the proximal phalanx. In this study, the abductor hallucis muscle was tight, and we performed sectioning of the tendinous part of the muscle at the base of the big toe, and immediate intraoperative passive correction of the forefoot adduction was achieved (Fig. 3). There were no hallux vagus deformities in this study.

Mitchell [16] reported that in true congenital metatarsus adductus there is a contraction or shortening of the abductor hallucis muscle and tendon which is considered to be the primary deforming factor. In the early severe or resistant deformity, correction can be achieved by either division of the tendon with release of its capsular attachment, or in the more severe deformity, by complete release of the abductor hallucis muscle from its extensive attachment to bone and soft tissues. Lichtblau [5] also recommended sectioning of the abductor hallucis tendon for early correction of the metatarsus adductus deformity, especially in the residual of a treated equinovarus foot.

Some authors performed more extensive soft tissue release for patients with metatarsus adductus at nearly similar age of this study. Heyman *et al.* [7] reported good and excellent results in only 9 patients with metatarsus adductus. Bleck [11] reported that the results were statistically significantly better when treatment was begun from ages 1 day to 8 months. No significant correlations with poor results were found using the severity and flexibility grading systems. Given the public attitude toward deformity, it seems wiser to treat in infancy the feet graded 'moderate' or 'severe.' If treatment is not commenced until the child is old enough to preclude conservative treatment, extensive surgery will be necessary to correct a 'severe' deformity. In this study, the age at the time of tenotomy had no statistically significant effect on the final outcome in spite of unsatisfactory results were found in patients older than 4 years.

## Conclusion

Abductor hallucis tenotomy for severe resistant metatarsus adductus followed by serial casting is simple, safe, and effective technique without significant postoperative morbidity. It shortens the time of casting, which decreases the risk of leg muscle atrophy. It is better to be done up to the age of 4 years.

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### Conflicts of interest

There are no conflicts of interest.

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